Fish bones and amphorae: evidence for the production and consumption of salted fish products outside the Mediterranean region

Wim Van Neer, Anton Ervynck and Patrick Monsieur

Spetta ora ad altri di determinare, se pur sarà possible,
a quale specie di pesci appartengano quegli avanzi.[1]

Introduction

Early in the year 1878, during his excavation of the vast amphora deposit near the Castro Pretorio in Rome, H. Dressel was shown a crust adhering to the inner surface of an amphora sherd, in which he recognised the scales and bones of fish. Dressel was probably the first archaeologist not only to identify the amphorae used for the storage and transport of fish products, but also to recognise the archaeozoological remains of the commodities once stored in them. At the moment of his discovery, he made the prophetic remark that perhaps future research on the remains of these ancient fish might make it possible to identify the species found in association with the amphora sherds.

Now, more than a century later, Dressel's hope has been fulfilled, and a multidisciplinary research project, combining the study of artefacts and biological remains, has become possible. The production, trade and consumption of fish sauces (*garum, hallex*,[2] *liquamen, muria*) and salted fish (*salsamenta*[3]) in the Roman period are amply documented by literary and epigraphic sources;[4] by the excavation and analysis of salting installations and salt production sites along the coasts of the Mediterranean and the Black Sea, as well as the Atlantic coasts of the Iberian peninsula and Gaul;[5] by the nearly ubiquitous remains of the transport amphorae used in the trade;[6] and, finally, by the archaeozoological analysis of the

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1 Dressel 1879, 93: "It is up to others, whenever it may be possible, to determine to which species of fish these remains belong". Cf. also *CIL* XV 2 4757.

2 The term *hallex* is attested in a variety of spellings: *allex*, *hallec*, *allec* (Curtis 1991), *halex* (*CIL* IV 5719), *alex* (Etienne and Mayet 2002) and *alec* (in a graffito on a *dolium* from Aardenburg, discussed below).

3 The term *salsamenta* is known only from ancient texts, not from *tituli picti*, and is used here to refer to salted fish, often of relatively large size, preserved whole or in cuts. In *salsamenta* the meat of the fish is still present as a relatively solid substance. Fish sauces, on the other hand, are liquids containing, among other ingredients, the dissolved soft parts (and sometimes also the skeletal elements) of mostly smaller fishes, or the dissolved soft parts or blood of larger fishes.

4 The ancient texts are collected by Curtis (1991); cf. also Grimal and Monod 1952 and Jardin 1961. For epigraphic texts, especially painted inscriptions and (rarely) *graffiti* on ceramics, see Dressel 1879; *CIL* IV suppl.; *CIL* XV 2; Colls *et al*. 1977; Liou and Marichal 1978; Liou 1987; Martin-Kilcher 1994; Liou and Rodríguez-Almeida 2000; Stuart and Bogaers 2001; Ehmig 2002 and 2003; Laubenheimer 2004.

5 Merlat 1957; Ponsich and Tarradell 1965; Sanquer and Galliou 1972; Galliou 1984; Pirazzoli 1987; Ponsich 1988; Curtis 1991; Etienne and Mayet 2002; Zimmermann 2003; Bekker-Nielsen 2005; Wilson 2006; Lagóstena, Bernal and Arévalo 2007; Slim *et al.* 2007; Driard 2008.

6 *CIL* XV 2; Zevi 1966; Beltrán Lloris 1970; Peacock 1974; Manacorda 1977; van der Werff 1984; Sealey 1985; Peacock and Williams 1986; Brentchaloff 1988; Desbat and Martin-Kilcher 1989; Laubenheimer 1990; Martin-Kilcher 1990; Dangréaux *et al.* 1992; Laubenheimer, Gébara and Béraud 1992; Martin-Kilcher 1994; Baudoux 1996; Desbat and Dangréaux 1997; García Vargas 1998; Ehmig 2003; Monsieur 2005.

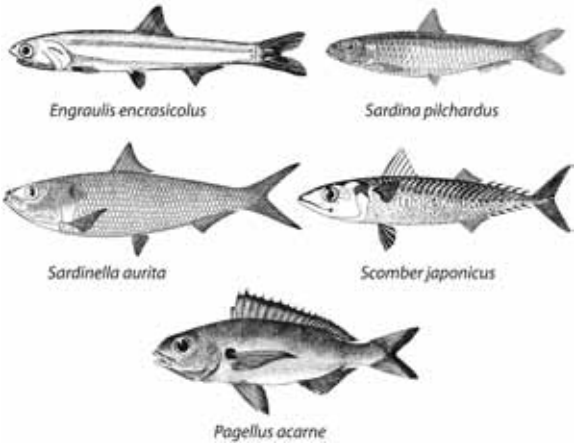

Fig. 1. Marine fish species typically used in Mediterranean fish sauces and *salsamenta*.

remains of the fish themselves. Studies of these remains have been undertaken in the past,[7] but they have recently become more frequent as a result of an increase in the practice of systematic sieving during excavation. A review of the evidence published by R. I. Curtis almost two decades ago[8] can now be updated with additional data on the contents of amphorae recovered from a number of Mediterranean shipwrecks[9] or consumption sites.[10] Studies of fish remains found in sediment samples from salting installations have also appeared.[11] As the amount of data has grown, criteria have been refined to allow more precise distinctions between fish sauces and *salsamenta*,[12] using the types of bones preserved, their anatomical positions, and the reconstructed body lengths of the corresponding fish.

On the basis of the faunal remains, a clear pattern emerges in the spectrum of species used in the preparation of S European and N African fish products (hereafter referred to as 'Mediterranean' fish products) in Roman times. The fish sauces were produced chiefly from clupeiform fishes: sardines (*Sardina pilchardus*), sardinella (*Sardinella* sp.) and, to a lesser extent, anchovies (*Engraulis encrasicolus*) (fig. 1). Sea breams (Sparidae) were also regularly used, albeit usually in smaller proportions. For (Mediterranean) *salsamenta*, the Spanish mackerel (*Scomber japonicus*[13]) was preferred, although the use of scad (*Trachurus* sp.) is also documented.[14] Nevertheless, in spite of the wealth of accumulated data, the identification of processed fish remains a complicated task, and there are still discrepancies between the archaeozoological evidence and that provided by the epigraphic and literary sources.

The study of these products has been further complicated and expanded by the fact that there is evidence not only for the consumption of Mediterranean salted fish products outside the Mediterranean region (a pattern previously noted but now much better documented), but also for the production of fish sauces and *salsamenta* using species that do not occur in the Mediterranean. The latter must represent local variants of the 'genuine' salted products, produced in areas away from the *mare nostrum*. In order to assess this phenomenon from an economic perspective, information must first be gathered about the consumption of imported Mediterranean fish products in those areas. In the following

7 von den Driesch 1980 is one of the earliest examples.
8 Curtis 1991.
9 Desse-Berset 1993a; Delussu and Wilkens 2000; Desse-Berset and Desse 2000.
10 E.g., Bruschi and Wilkens 1996; Delussu and Wilkens 2000; Roselló *et al*. 2003.
11 Desse-Berset and Desse 2000; Sternberg 2000; Morales, Roselló and Bernal 2004; Gabriel, Fabrião and Filipe 2009.
12 Desse-Berset and Desse 2000.
13 The Latin names of species are subject to changes as a result of ongoing taxonomic study. The Spanish mackerel is now officially designated *Scomber colias*, but we prefer to retain the name that has long been used in the archaeozoological literature.
14 Desse-Berset and Desse 2000.

discussion, we first summarise the archaeozoological evidence for Mediterranean fish sauces found outside the Mediterranean region. Next, we do the same for *salsamenta*. Finally, we discuss fish processing in Roman times outside the Mediterranean region. As far as possible, we attempt to integrate the osteological data with other evidence, especially that provided by amphorae and inscriptions.

Evidence for Mediterranean fish sauce outside the Mediterranean region

There is ample evidence for the consumption of Mediterranean fish sauces and salted fish north of the Mediterranean region. Amphorae, and in particular their *tituli picti* (painted inscriptions), form the bulk of the evidence, supplemented by a few other written documents: e.g., a graffito, probably to be read as *gar*(*um*) *sec*(*undarium*), on a Dressel 6B amphora from Magdalensberg;[15] a funerary inscription of a *murarius* (a merchant in fish sauce) from Lyon;[16] and a reference to *muria* on a wooden tablet at Vindolanda.[17] Only in two instances do faunal remains attest to the presence of a Mediterranean fish sauce in an amphora found outside the Mediterranean region. In one of these, the bones from a Dressel 6A amphora found at Salzburg correspond to a sauce made chiefly from sardines, anchovies and sparids.[18] In the other, the contents of a Baetican amphora of Dressel type 7-11 from Mainz, dated *c.*A.D. 100, have been interpreted as *garum scombri*[19] or *allex scombri*,[20] because of the exclusive presence of head bones of Spanish mackerel. Since *garum* usually contains few or no bones, *hallex*, an unstrained variety of sauce, seems a more appropriate identification in this case.[21] Unfortunately, in neither case was a *titulus pictus* present on the amphora.

Painted inscriptions on amphorae are still the principal evidence for the export of fish sauce beyond the Mediterranean region, and in spite of the fragility of such inscriptions a significant number of them have survived, especially at Augst and Mainz.[22] Apart from the names of the merchants, these *tituli picti* sometimes carry information about the quality, quantity, origin and, above all, the type of fish product (*hallex*, *garum, liquamen* or *muria*) originally stored in the container. While the term *hallex* almost never appears in *tituli*,[23] the other three terms are frequently attested. Although the precise nature of the products remains somewhat unclear,[24] each name must correspond to a particular type of preparation and a specific set of ingredients; it is hardly believable that these terms were used indifferently, as is sometimes suggested. In surveys of *tituli picti* by U. Ehmig and F. Laubenheimer,[25] the various terms for fish sauces appear with the following

15 Maier-Maidl 1992, 110.
16 *CIL* XIII 1966.
17 *Tab. Vindol.* II 190; cf. Bowman 1994, 115-17.
18 Lepiksaar 1986; Ehmig 2003.
19 Ehmig 2001.
20 Ehmig 2003; cf. id. 1995.
21 It is generally accepted that the term *garum* represents a top-quality fish sauce produced by decanting the volume of fermented fish, dissolved salt and other ingredients in order to obtain a liquid clear of any solids. *Hallex* appears to have been a product of lower quality, containing fish bones, scales, etc. On these distinctions, see Curtis 1991.
22 Martin-Kilcher 1994; Ehmig 2003.
23 There seems to be only one certain example: an African, neo-Punic Dressel 18 amphora found in Rome, with the inscription *HAL(lex/c)*: Dressel 1879, no. 86.
24 See Curtis 2005.
25 Ehmig 2003; Laubenheimer 2004. These studies draw together data from the entire Roman em-

frequencies: on Baetican amphorae (n=79), *garum* 60.5%, *muria* 14% and *liquamen* 25.5%; on Gallic amphorae (n=41), *garum* 37%, *muria* 51% and *liquamen* 12%.

Several other terms for fish products also appear in *tituli picti*. In spite of their regular occurrence,[26] however, the meaning of terms such as *laccat*(*um?*) and *lympha*(*tum?*) remains obscure, and even the way in which the abbreviations are to be completed is uncertain. There seems to be a growing consensus that these are types of *salsamenta*, but they have also been interpreted as fish sauces, prepared, in the case of *laccat*(*um?*), with a spice called *lacca*, and in the case of *lympha*(*tum?*), mixed with water (*lymphare*) and resembling the *hydrogarum* mentioned in ancient texts.[27] Interesting, although rare, is the abbreviation *miscell,* probably to be completed as *miscell*(*um*) or *miscell*(*anea*). So far recognised only on Beltrán IIA (Dressel 38) amphorae of the Flavian period found in Rome and Fréjus, it may refer to a sauce made from several different species of fish.[28] If so, the mixed content in the Dressel 6A amphora from Salzburg (noted above) was perhaps derived from a product of this sort. An amphora of Vindonissa type 586 or Beltrán type IIA from the Chiessi wreck, which also appears to have contained more than one species, may provide a comparable example from the Mediterranean region.[29] The name of the fish used in the product is not normally mentioned in the *titulus*. An exception is the specification *scombri,* which is often added to *tituli* of *garum* and *liquamen*, although it is difficult to know whether this was the rule in such cases.[30] (No example of the use of *scombri* in combination with *muria* is found among surviving *tituli*.)

No distinction can be made, on the basis of the amphora typology alone, between the trade in *salsamenta* and that in fish sauce. Still, within the group of amphora types identified by their *tituli picti* as containers for fish products, a reasonable number must have been used for the latter, as indicated by the frequency of the *tituli picti* referring to them.

The typologies of the amphorae provide important clues to dating and, in combination with fabric analysis and the study of the *tituli picti*, make it possible to identify the Mediterranean origins (in *Baetica*, *Tarraconensis*, *Narbonensis*, Lyon, *Dalmatia*, *Lusitania* or *Africa*) of the containers and their contents. The high point of the export of these products beyond the Mediterranean region was in the 1st c. A.D., with destinations concentrated in *Gallia*, *Germania*, *Britannia, Raetia, Noricum* and *Pannonia*.[31] During the 1st c. *Baetica* was the most important exporter, followed by Lyon, *Narbonensis* and *Tarraconensis* (although we are poorly informed about the last).[32]

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pire, but chiefly from Augst, Mainz, Pompeii, Lyon and Rome itself.

26 Liou 1993; Etienne and Mayet 2002; Ehmig 2003.

27 *CIL* XV 2 2736; Manacorda 1977; Liou 1993; Martin-Kilcher and Schillinger-Häfele 1989-90; Etienne and Mayet 2002.

28 *CIL* XV 2; Zevi 1966; Liou 1992; Liou and Rodríguez-Almeida 2000.

29 This amphora was wrongly identified in the publication of the wreck as Vindonissa 583, a type which corresponds to Haltern 70, used for the transport of olives (cf. Ettlinger and Simonett 1952, pl. 26, no. 583). There can be little doubt that either Vindonissa 586 or Beltrán IIA, two closely related types, is meant instead. It is not clear why U. Ehmig (2003, 79, Table 11) distinguishes two amphora types (Beltrán IIA and Vindonissa 586) in the Chiessi wreck, while T. Bruschi, F. Delussu and B. Wilkens speak of only one type (Bruschi and Wilkens 1996; Delussu and Wilkens 2000).

30 Because many of the texts are not completely preserved, it is not possible to compare the relative numbers of *tituli picti* with and without the addition of *scombri*.

31 Hawkes and Hull 1947; Peacock 1971; van der Werff 1984; Sealey 1985; Peacock and Williams 1986; Bezeczky 1987; Desbat and Martin-Kilcher 1989; Laubenheimer 1990; Maier-Maidl 1992; Brulet, Laubenheimer and Vilvorder 1992; Bezeczky 1993; Martin-Kilcher 1994; Davies, Richardson and Tomber 1994; Monsieur and Braeckman 1995; Baudoux 1996; Williams and Desbat 1999; Schindler Kaudelka 2000; Ehmig 2001 and 2003; Monsieur 2005.

32 Beltrán Lloris 1970; Desbat and Schmitt 1998; Liou 1998.

Fig. 2. Lyonaise amphora (3B type) for fish sauce, from the *vicus* of Velzeke (*Gallia Belgica*) (Provincial Archaeological Museum of Velzeke).

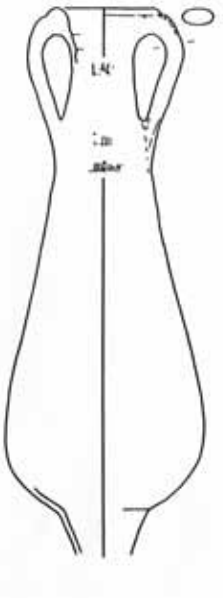

Fig. 3. Baetican amphora (Beltrán IIB type) for fish products, from Augsburg (*Raetia*) (Ehmig 2001, 61 fig. 7).

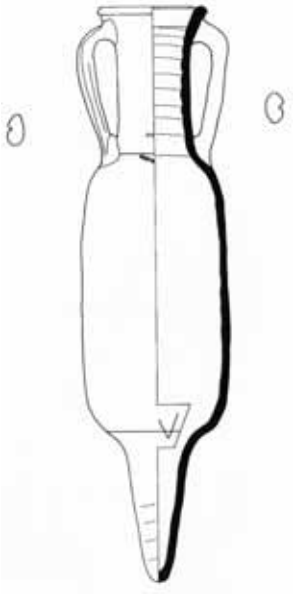

Fig. 4. Baetican amphora (Dressel 14A type) for fish products, from Leiden-Roomburg (*Germania Inferior*) (Hazenberg 2000, 43 fig. 24).

Baetican amphorae are found in the north from the Augustan period onward, although rarely at Iron Age sites and then mainly in élite graves (see below on the evidence from the Titelberg). They appear first in military camps and gradually also in urban centres, but remain virtually absent at rural sites. *Tituli picti* on Dressel 12 and 9 amphorae of Augustan date are probably the oldest examples. The predominance of Baetican (and to a lesser extent, Tarraconese) Dressel 9 and 12 amphorae in the first decades of the century is followed by a gradual increase in the numbers of Dressel 8-9, Vindonissa 586/Pompéi VII, and Beltrán IIA types.[33] Little is known of amphorae from *Tarraconensis* (mostly imitations of Baetican types) and *Narbonensis* (Fréjus-Lenzbourg and Dressel 16 types).[34] *Tituli picti,* fabric analysis and workshop studies have shown that eastern Narbonese amphorae produced in Fréjus, Cassis and Cannes were used to export fish sauce from *Antipolis,* as demonstrated by the Fréjus-Lenzbourg type and the discovery of a Dressel 16 amphora with a *titulus* in London.[35] The Narbonese Fréjus-Lenzbourg type is attested only in the north, but examples of the Dressel 16 have been found in Ostia and Rome as well.

The production of amphorae for fish products in Gaul, especially at Lyon, is probably still underestimated, in part because they have not always been correctly identified.[36] Lyonaise amphorae,

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33 The discovery of a Campanian Dressel 21-22 amphora at Colchester is exceptional: Williams and Desbat 1999; Botte 2009.

34 Narbonese imitations of Baetican types also exist; they do not seem widespread, but this does not rule out their possible presence in the north: Laubenheimer 1989.

35 Peacock and Williams 1986; *RIB* 2492, 29; Brentchaloff 1988; Brentchaloff and Picon 1990; Laubenheimer, Gébara and Béraud 1992.

36 Monsieur, De Paepe and Braet 2007. Because of their rough and sandy fabric, amphora fragments from Lyon are often confused with *dolia* and *mortaria* and classified as such. When properly identified, however, they can appear in significant quantities at northern sites. In a quantification of the amphora fragments from 4 refuse-pits excavated in the *vicus* of Velzeke (Belgium) and dated to the period *c.*A.D. 50-90, amphorae from Lyon represented 20% of all imported examples and 40% of those used for fish products (the other 60% being Baetican).

for which fabric analysis has provided decisive proof of origin, occur from the reign of Tiberius onward, and were widely exported to *Gallia Belgica*, *Germania* and *Britannia*, but apparently never to the south.[37] Of the 14 types known, most of them imitations of Greek, Italic, Baetican and Narbonese types, 7 were used to transport fish products (fig. 2). The *tituli* on these amphorae mention all three kinds of fish sauce, and the term *garum* is sometimes accompanied by the modifier *scombri*. Most remarkable is the appearance in the inscriptions of geographic labels: *Antipol*(*itanum*/*-a*) (8 examples) and *Hisp*(*anum*/*-a*) (5 examples). These fish sauces must have been of Mediterranean origin. It is assumed that they were transported in bulk, probably in wooden casks, to Lyon, where they were decanted into locally-made amphorae for distribution.[38] Even if the geographic labels were intended to refer to a specific recipe or method of preparation, the fact that the amphora types of S Gaul and Spain were imitated by the manufacturers in Lyon suggests that the contents had their origins in those regions.[39]

Most of these amphora types disappeared at the end of the 1st or during the first half of the 2nd c. A.D. Evidence of amphorae used to transport fish products in the north in the 2nd c. is very poor, although the reasons for this (sudden?) decline remain unclear. Among the rare examples found in the northern provinces during this period, the Baetican Beltrán IIB and Dressel 14A amphorae seem to be the most frequent types. Three examples of Beltrán IIB with *tituli picti* discovered in Augst, Augsburg (fig. 3) and Strasbourg can be assigned to the first half of the 2nd c.[40] The 'Little Russel A' shipwreck near St. Peter Port (Guernsey) yielded Beltrán IIA and IIB amphorae pointing to a date around A.D. 100.[41] A Dressel 14A amphora discovered in the *vicus* near the fortress of Matilo (Leiden-Roomburg) (fig. 4) can be assigned to the same period.[42] Amphorae with fish products from *Lusitania* and *Africa* occur more frequently from the 3rd c. onward, but remain rare outside the S Atlantic and Mediterranean regions (see below).

In this context, the discovery of the fish bones in the Dressel 6A amphora at Salzburg is remarkable, since Dressel 6A and 6B are Adriatic types usually thought to have been used for the transport of wine and olive oil, respectively, during the Augustan period and the 1st c. A.D. It appears that they were also sometimes used (or re-used?) for fish sauce. The lack of a standard form of amphora for use with fish products seems to have been typical for the Adriatic area, even in the 2nd c. A.D., to judge from the re-used amphorae of different origins found in the Grado shipwreck.[43] Although the production of *muria* in Dalmatia in the 1st c. A.D. is confirmed by the texts (Plin., *NH* 31.94), little is known about the fish products of the Adriatic, and the fish sauce produced in *Dalmatia* (and possibly other parts of the Adriatic region) seems to have been exported chiefly to N Italy, *Noricum*

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37 Schmitt 1988; Desbat 1991; Dangréaux *et al.* 1992; Martin-Kilcher 1994; Desbat and Dangréaux 1997; Schmitt 1998; Monsieur and Braeckman 1999; Laubenheimer 2004; Monsieur, De Paepe and Braet 2007; Monsieur 2010.

38 Monsieur and Broeckaert, forthcoming.

39 In *Hispania* the source could be *Baetica* as well as *Tarraconensis*. Because the Tarraconese amphorae used for fish sauce soon died out, and were themselves copies of Baetican types (see, e.g., Liou 1993 for a Dressel 9 type, and Desbat and Schmitt 1998 for a Dressel 12), it seems more likely that the sauce came from *Baetica*.

40 Augst: Martin-Kilcher 1994 and Ehmig 2001 (both with *tituli* identifying the contents as *lacc*(*atum*). Strasbourg: Baudoux 1996 (associated with a coin of Hadrian; *titulus* not yet satisfactorily deciphered).

41 'Little Russel A' shipwreck: Monaghan 1990; Etienne and Mayet 2002. It is difficult to determine whether the amphorae found in 2nd-c. contexts in the north are residual or newly imported. Augst appears to be one of the few known sites with contexts for this period.

42 *Matilo:* Hazenberg 2000; parts of a *titulus* are preserved but illegible.

43 Auriemma 2000.

and *Pannonia*. In the 2nd c. a small amphora for fish sauce, called the 'Grado type', was produced somewhere in the Adriatic region. These bear *tituli picti* mentioning *muria,* but again their diffusion seems to be restricted, in this case to sites in the middle and northern Adriatic.[44]

Evidence for the consumption of Mediterranean fish sauce in the eastern and southern parts of the empire on sites located a considerable distance from the coast is scarce. Fish sauce from the W Mediterranean was found at Masada, an example of a product transported over a long distance but still consumed within the Mediterranean basin.[45] The same is true of three Baetican amphorae of the Beltrán IIA type found at Tarsus, although in this case it is not possible to determine if they contained fish sauce or *salsamenta*.[46]

The archaeozoological evidence for the export of Mediterranean fish sauce is very limited compared with that provided by the amphorae and their *tituli picti*. Because the production of fish sauce involved filtering or decanting, and in some cases only the soft tissue (blood and intestines) was used, fish sauce is often 'archaeologically invisible'. Only those products containing scales or bones leave obvious traces in the archaeological record. The identification of fish products through biomolecular analyses of lipids,[47] DNA[48] or peptides[49] may offer a way around this limitation, but it remains to be seen whether these methods will allow taxonomic identification that is precise enough to establish the nature and provenance of the products.

Evidence for Mediterranean *salsamenta* outside the Mediterranean region

With the exception of the bones found in the containers of fish sauce at Salzburg and Mainz (noted above), all of the Mediterranean fish products documented by faunal remains in the northern part of the empire belong to the category of *salsamenta*. With the development of archaeo-ichthyological techniques in recent decades and the increase in systematic sieving during excavation, the number of sites from which such remains have been recovered is growing rapidly.

In the northern part of the empire, *Scomber japonicus*, the species of mackerel typical of the Mediterranean and the Atlantic coasts of S Europe, appears to be the most commonly imported salted fish (Table 1). The bones of this species (mainly vertebrae) have been found at a number of Roman sites far from its natural area of distribution, including at least 15 in Switzerland, 4 in Germany, 1 in Austria, 5 in Great Britain, 4 in the Netherlands, 5 in Belgium and 1 in Luxembourg.[50]

Remains of *Scomber japonicus* found at inland sites in N Spain and S France must also be considered evidence for imported *salsamenta*, if the distance from the coast is too great for the fish to have been transported fresh. It has been suggested that the remains found at

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44 Auriemma 2000; Pesavento Mattioli 2000; Fabrini and Marengo 2002; Forti 2004; Monsieur 2007.

45 Cotton, Lernau and Goren 1996. The provenance is based on the amphora types found at the site.

46 Jones 1950, nos. 790-92.

47 E.g., Silvino, Poux and Garnier 2005.

48 Piquès, Hänni and Silvino 2008.

49 Heaton *et al*. 2009.

50 Further evidence of the trade in Mediterranean salted fish is the vertebra of a barracuda (*Sphyraena* sp.), another fish typical of southerly waters, found in a context of the 4th c. A.D. at Nijmegen: Lauwerier 1988.

TABLE 1
SITES OUTSIDE THE MEDITERRANEAN REGION THAT HAVE PRODUCED EVIDENCE FOR THE CONSUMPTION OF *SCOMBER JAPONICUS* AS *SALSAMENTA*

Site	*Date (all are A.D. except as noted)*	*Context*
Belgium		
Velzeke, De Roover[1]	3rd quarter of 1st c.	domestic refuse from *vicus*
Tienen, mithraeum[2]	2nd half of 3rd c.	refuse from ritual meal
Tongeren, Minderbroederstraat[3]	2nd half of 2nd c.	domestic refuse from town
Tongeren, Veemarkt[4]	end of 1st-1st half of 2nd c.	domestic refuse from town
Tournai, CV12[5]	2nd-5th c.	domestic refuse from town
Germany		
Dangstetten[6]	15-9 B.C.	food refuse from military camp
Xanten, *Insula* 39[7]	2nd quarter of 2nd c.	food refuse from well in town
Karden[8]	1st-4th c. (1 bone of 1st-mid 2nd c.)	temple
Frankfurt, Gross Gerau[9]	75-120	food refuse from *vicus*
Luxemburg		
Dalheim[10]	3rd c.	offering pits near temple in *vicus*
United Kingdom		
Skeleton Green, Stevenage[11]	Late Iron Age	*oppidum*
Chester, 25 Bridgestreet[12]	end of 1st-early 2nd c.	garrison town
Boreham, Great Holts Farm[13]	3rd-4th c.	domestic refuse from villa
St. Albans, Gorhambury[14]	1st-2nd c.	domestic refuse from villa
Southwark, Winchester Palace[15]	1st c.	in amphora from military context
The Netherlands		
Nijmegen, Kopse Hof[16]	1st c.	in amphora from military settlement
Nijmegen, Kopse Hof[17]	12 B.C.-A.D. 24	in latrine of military settlement
Nijmegen, Canisiuscollege[18]	*c.*100	food refuse from military settlement
Velsen 1[19]	1st half of 1st c.	food refuse from military settlement
Switzerland		
Augusta Raurica, Nordwest-gräberfeld[20]	2nd half of 1st c. to 1st half of 2nd c.	food offering in wealthy grave from town
Augusta Raurica, *Insula* 1[21]	1st half of 2nd c.	food refuse from town
Augusta Raurica, Kastelen[22]	3rd c.	food refuse from town
Augusta Raurica, Areal Frey[23]	probably 2nd-3rd c.	food refuse from town
Kaiseraugst Tophaus[24]	2nd c.	food refuse from town
Tenedo-Zurzach[25]	10-20	food refuse from castle
Neftenbach, Bau 25[26]	4th quarter of 1st c. to 1st half of 2nd c.	food refuse from villa (*pars urbana*)
Aventicum[27]	1st-3rd c.	food refuse from town
Petinesca[28]	3rd c.	food refuse from *vicus*
Reinach, Mausackerweg[29]	70-130	food offering in wealthy grave
Vindonissa[30]	10 B.C.-A.D. 1	food refuse from town
Vindonissa, Windisch-Dägerli[31]	2nd quarter of 1st c. to mid-2nd c.	food offering in wealthy grave from town
Vindonissa, Römerblick[32]	1st c.	officers kitchen
Martigny[33]	3rd-4th c.	food refuse from mithraeum
Biberist[34]	1st-3rd c.	food refuse from villa (*pars urbana*)
Austria		
Virunum[35]	early 2nd-early 4th c.	food refuse from town

Site	*Date (all are A.D. except as noted)*	*Context*
France		
Biesheim-Kunheim ("Oedenburg")[36]	20-80	from ceramic containers in military camp and in *vicus*
Lyon, Kybele sanctuary[37]	10-15	food refuse from banquet
Lyon, Parc Saint-Georges[38]	3rd c.	refuse from domestic and harbour activities
Nîmes, Place d'Assas[39]	60-70	food refuse from town
Spain		
Iruña-Veleia[40]	2nd half of 2nd c.-3rd c.	food refuse from wealthy residence in town
Labitolosa[41]	1st c.	food refuse from town

1 Ervynck, Van der Plaetsen and Van Neer 1999.
2 Vanderhoeven *et al*. 2001; Lentacker, Ervynck and Van Neer 2004.
3 Vanderhoeven *et al*. 1994.
4 Re-examination of the small fish remains mentioned in Vanderhoeven *et al*. 1993 revealed a vertebral fragment of a mackerel (*Scomber* sp.), measuring 30-40 cm. It is assumed to represent Spanish mackerel (*S. japonicus*), since that is the only marine taxon at the site.
5 Lentacker, Van Neer and Pigière forthcoming.
6 Van Neer, pers. obs.; Fingerlin 1986 and 1998.
7 Pöllath and von den Driesch 2003.
8 Benecke 1999.
9 Hüster Plogmann 2009.
10 Oelschlägel 2006.
11 Wheeler 1981.
12 Jaques *et al*. 2008.
13 Murphy *et al*. 2000.
14 Locker 1990.
15 Yule 1989 and 2005; Locker 1994.
16 Lauwerier 1993 and pers. comm.
17 Lauwerier 1993 and pers. comm.
18 Hoek and Brinkhuizen 1990; Brinkhuizen, pers comm.
19 Brinkhuizen 1989.
20 Veszeli 1996.
21 Hüster Plogmann 1999b.
22 Hüster Plogmann 2002.
23 Hüster Plogmann, pers. comm.
24 Hüster Plogmann 2003a.
25 Morel 1994.
26 Hüster Plogmann 1999a.
27 Ambros 1990; Hüster Plogmann, pers. comm.
28 Hüster Plogmann, Grundbacher and Stopp 2007.
29 Hüster Plogmann, pers. comm.
30 Hüster Plogmann 2003b.
31 Hinterman 2000; Hüster Plogmann, pers. comm.
32 Hüster Plogmann and Häberle, pers. comm.
33 Wiblé 1995; Olive 2004.
34 Hüster Plogmann 2006b.
35 Galik 2004. Finds are from contexts both before and after 275 (Galik, pers. comm.).
36 Hüster Plogmann 2006a and forthcoming.
37 Piquès, Hänni and Silvino 2008.
38 Ibid.
39 Piquès 2006.
40 Morales and Roselló 2008.
41 Lignereux *et al*. forthcoming and pers. comm; Sillières *et al*. 1995.

Iruña-Veleia (Cantabria) are not those of local fish, but rather imports from more distant centres of production,[51] and the same is presumably true of the remains from *Labitolosa* (central Pyrenees).[52] Finds of the 1st c. A.D. from Nîmes must represent fish caught and processed on the S coast of France, as indicated by the amphorae and their *tituli*. At Lyon, Spanish mackerel has been found in contexts of the 1st and 3rd c. A.D.; the latter examples, from Parc Saint-Georges, are believed to have come from Iberian or N African salteries.[53] This conclusion has been corroborated by the discovery of large numbers of N African amphorae, proving that the town served as a centre for the import of salted fish and its distribution further inland. Some of the amphorae are of Africana II type, from around Salakta *(Byzacena)*; others are of undetermined type.

51 Morales and Roselló 2008.
52 Lignereux *et al*., forthcoming
53 Piquès 2006; Piquès, Hänni and Silvino 2008.

The remains of scad (*Trachurus* sp.), another taxon used in the production of salted fish in the Mediterranean region,[54] have also been found in northern parts of the empire. Unlike the finds of Spanish mackerel, however, these cannot be seen as firm evidence for long-distance import, because *Trachurus* also occurs naturally in northern waters. Nevertheless, where the remains of *Trachurus* are found together with those of *Scomber japonicus,* as at Great Holts Farm (Essex)[55] and at Tournai,[56] the combination may be significant. In Great Britain, the presence at certain sites of sparids (Sparidae sp.), red mullet (*Mullus surmuletus*) or wrasses (Labridae sp.) has also been interpreted as possible evidence for import from the south. This is the case at Tanner Row in York, where contexts dated between the late 2nd and the early to mid-3rd c. have yielded remains of sparids which have not been identified with certainty, but which appear to represent species that do not occur in British waters.[57] Sparids have also been found in a Roman well at The Bedern, another site in York.[58] If these remains were small, they might have been derived from fish sauce; if large, they would presumably represent salted fish, although fish of this family were apparently used only rarely for the production of *salsamenta*. Unfortunately, no information about size is available for any of the relevant contexts. Moreover, since several members of the sparid family occur along the British coasts, further analysis will be needed to confirm that the material found at York was actually imported from the Mediterranean region. Finally, remains of red mullet and wrasse have been reported from a 2nd-3rd c. context at Thornborough Farm, Catterick Bridge (Yorks.).[59] Red mullet has also been found at Creyke Beck, Cottingham, an Iron Age site.[60] It is unclear, however, whether this should be seen as evidence for the pre-conquest import of fish from the south: because both wrasse and red mullet also occur in N Atlantic waters, albeit rarely, they cannot be certainly identified as imports.

The osteological evidence for the import of Mediterranean *salsamenta* in the northern parts of the empire seems to cover the whole Roman period, although the majority of the finds are early (Table 1). The pattern is thus different from that seen in the import of Mediterranean fish sauces. For the sake of completeness, two occurrences of *salsamenta* in earlier periods, prior to the Roman occupation, should also be mentioned, although these are probably to be interpreted as the result of exchange between Romans and the local Iron Age élites. One of them, a find of *Scomber japonicus* from a Late Iron Age context at Skeleton Green, Stevenage (Herts.), is the only firm indication of the import of this species before the Roman conquest.[61] The other is a tuna vertebra from the *oppidum* of the Titelberg.[62] This has been tentatively identified as albacore (*Thunnus alalunga*), a species typical of tropical and temperate waters, including the Mediterranean. In the Atlantic it is found north to the Gulf of Gascoigne in summer, and even near the south coast of Brittany. Occasional occurrences of isolated individuals have also been reported as far north as the mouth of the Rhine.[63] Even if this specimen was caught in the northern Atlantic, however, curing would have been necessary to preserve it long enough for transport to the site of the Titelberg.

Since it cannot be determined on the basis of form alone whether an amphora contained fish sauce or other salted fish products, our ability to reconstruct patterns of trade in *salsamenta* using amphora typologies and chronologies is as limited as it is in the case of the sauces. Under the Flavians, however, and even in the Neronian period, Baetican amphorae

54 Desse-Berset and Desse 2000.
55 Murphy *et al*. 2000.
56 Lentacker, Van Neer and Pigière, forthcoming.
57 O'Connor 1988, 115.
58 Kenward, Hall and Jones 1986.
59 Stallibrass 2002.
60 Stallibrass 1997.
61 Wheeler 1981.
62 Desse-Berset 1993b.
63 Wheeler 1978.

(Vindonissa 586/Pompéi VII, Beltrán IIA and Dressel 14A types) tended to become larger. These bulky containers, with their wide mouths and capacious bellies, could have been designed specifically for the transport of *salsamenta*, although *tituli picti* prove that they were also used for fish sauce, a fact confirmed by the contents of amphorae found in shipwrecks.[64] *Salsamenta* were also transported in other containers, as demonstrated by the presence of mackerel in a globular pot of Hispanic origin found in the Early Imperial headquarters of the fort on the Kops plateau at Nijmegen.[65] This is a very rare example, but it may be that not enough attention is paid to this kind of pottery.

That the term *salsamenta* does not occur in surviving *tituli picti* hampers the study of the trade in salted fish products. Nevertheless, at least some of the terms of uncertain meaning that occur frequently in the *tituli* — e.g., *cord*(*yla*), *co*(*r*)*d*(*yla*), *saxitanus*, *lympha*(*tum?*) and *laccat*(*um?*) — probably indicate types of *salsamenta*, although the species involved and the nature of the processing remain obscure. The strongest cases can be made for *cordyla* and *saxitanus*. Indeed, most specialists agree that the abbreviations *cord* and *cod* should be expanded to *cordyla*, a term for young tuna found in ancient texts.[66] The *tituli* on Baetican amphorae, among them the Dressel 9 and Dressel 7/8 types, make it clear that these containers were used to transport not only fish sauces but also *cordyla*. Several amphorae of these types have been reported in the British Isles, raising the possibility of an early date for the import of the product there. Apart from the sites of Mount Bures (Essex), Silchester, and Colchester Sheepen, however, there seems to be a recurring difficulty in distinguishing pre-conquest from early Roman levels.[67] Whether the interpretation of *cordyla* as tuna helps to explain the tuna vertebra from the Titelberg (noted above) remains to be seen. In the territory of this *oppidum,* one of the main centres of the *Treveri*, who were Roman allies during and after the Gallic War, the graves of the élite contained the first Baetican fish sauce amphorae of the Dressel 12, 9 and 7/8 types to appear in N Gaul.[68] Whether these contained *salsamenta* (in this case, salted tuna), however, or merely fish sauce is unknown. In contrast to *cordyla*, *saxitanus* is actually known from only one well-preserved *titulus*, on a Baetican Dressel 14A amphora that was part of the cargo of the Gandolfo shipwreck (Almería), dated to the Flavian period. There is no doubt about the reading, or about the interpretation of the term by B. Liou and E. Rodríguez-Almeida as a species of fish.[69] Even if *saxitanus* originally referred to *Saxi* or *Sexi* (Almuñecar), a well-known fish-processing centre, it ultimately became the name of a species that ancient authors equate with *colias* (Plin., *NH* 32.146; Athen., *Deip.* 3.121a). Unfortunately, the precise meaning of *colias* remains uncertain. It has been suggested that the name denotes a scombrid, possibly larger than a mackerel, since it was cut into pieces during preparation.[70] Most of the problems surrounding the meaning of these terms will be solved only when a combination of evidence becomes available, such as an amphora found with both the contents and the *titulus* completely preserved. In any case, the osteological evidence for *salsamenta* for the northern part of the empire does not yet cover the whole range of species used for salted fish products.

Scarce as they are, the *tituli picti* do provide some data on the frequency of the trade in fish sauces as opposed to that in *salsamenta*. For Baetican amphorae, the lists compiled by

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64 See the lists in Ehmig 2001 and 2003.

65 Lauwerier 1993; van Enckevort *et al.* 1996. The same type of Hispanic pot seems to be present on the Port-Vendres II shipwreck of Claudian date: Colls *et al.* 1977.

66 See Marichal 1975; Liou 1987; Martin-Kilcher and Schillinger-Häfele 1989-90; Liou and Rodríguez-Almeida 2000; Etienne and Mayet 2002, 39; Liou and Silvino 2005.

67 Peacock 1971; Sealey 1985.

68 Thill 1967; Metzler *et al.* 1991; Metzler 1995; Monsieur 2003. For various reasons (including the flexible use of many amphora types, the recurring presence of Italic wine amphorae in Celtic graves, and the identification of contents by gas-chromatography), some scholars consider these early amphora types to be containers for Baetican wine: Silvino, Poux and Garnier 2005. Nevertheless, we still prefer to treat these amphorae as the earliest evidence for the import of Baetican fish products.

69 Liou and Rodríguez-Almeida 2000.

70 See discussion in Etienne and Mayet 2002.

Ehmig and Laubenheimer show the following distribution of *tituli* naming various types of fish products (n=167): *garum* 29%, *muria* 6.5%, *liquamen* 12%, *cordyla* 22%, *saxitanus* 0.5%, *laccat*(*um?*) 7% and *lympha*(*tum?*) 23%.[71] This suggests that *cordyla, saxitanus, laccat*(*um?*) and *lympha*(*tum?*) (all *salsamenta*?) must have been important products, since they represent *c.*50% of the total. *Cordyla* and *saxitanus* alone, both of which can be identified with reasonable confidence as *salsamenta*, account for 22.5%. The distribution of *tituli* on Gallic amphorae (n=41) is *garum* 37%, *muria* 51% and *liquamen* 12%. No example of a *titulus* naming *cordyla, saxitanus, laccat*(*um?*) and *lympha*(*tum?*) has yet been found in the Gallic group, which suggests that Narbonese and Lyonaise amphorae were not used to transport *salsamenta*.[72] Taking the Baetican and Gallic amphorae together, 57.5% of the surviving *tituli* name fish sauces.

Osteological evidence for Mediterranean *salsamenta* on inland sites in the E Mediterranean region is very scarce and sometimes circumstantial (Table 2). The only site in Anatolia at which the import of salted fish is documented is Sagalassos, *c.*120 km north of Antalya. With the exception of a few bones of grouper (*Epinephelus* sp.), sea breams (Sparidae) or jacks (Carangidae), the Mediterranean species found there in contexts of the 1st-7th c. A.D. are all Scombridae. These include *Auxis* sp. (bullet tuna or frigate tuna), *Sarda sarda* (Atlantic bonito), *Scomber japonicus* (Spanish mackerel), and unidentified species of *Scomber* (mackerel) and *Thunnus* (tuna). A series of domestic contexts in an urban residence and the E portico of the lower agora at Sagalassos yielded abundant faunal remains corresponding to kitchen and table refuse chiefly of the Early Byzantine period.[73] These assemblages of the 6th and 7th c. A.D. contained high proportions of fish bones, among which those of freshwater species dominate. The proportion of marine species is always low: they represent between 2% and 7% of the total quantity in contexts that yielded more than 100 fish bones, and consist almost exclusively of scombrids. No significant concentration of scombrid bones has been found, nor are they associated with a particular type of vessel, but the simple fact that the marine fish component at Sagalassos consists almost exclusively of scombrids is itself a good indication that they represent salted products. It is not clear where in the region such products might have been produced. The only salting installations so far known in Anatolia (and indeed in whole of the E Mediterranean) are in Lycia, which was apparently a good fishing ground for tuna and other scombrids: at Teimiussa, near Üçağız, four buildings have been discovered with up to 20 salting vats which were operating in the Imperial and Early Byzantine periods;[74] other such installations have been

71 Ehmig 2003; Laubenheimer 2004. *Saxitanus* has been added to the list on the basis of Liou and Rodríguez-Almeida 2000. These figures may be biased by the uneven preservation of *tituli picti*, which vary greatly in quantity depending on the site. Indeed, it is clear that the survival of the majority of *tituli* is due to very specific (in many cases wet) conditions, which protected them from deterioration. Large deposits of amphorae used in the filling of ditches and for building purposes are well known from cities such as Rome, Augst and Mainz, and a significant additional percentage of surviving examples comes from the Vesuvius region. Shipwrecks are another propitious environment for the preservation of painted inscriptions.

72 Since the precise meanings of most of the terms for fish products remain uncertain, a comparison between Baetican and Gallic production is difficult. In a Gallic context, for example, *muria* may refer to a by-product of *salsamenta* production (cf. Col., *RR* 12.55.4; Plin., *NH* 31.83), which was transported in amphorae, while the salted fish itself was perhaps transported in a different way.

73 Putzeys 2007.

74 Zimmermann 2003.

TABLE 2
QUANTITIES OF SCOMBRIDS AND OTHER MARINE FISH AT E MEDITERRANEAN SITES OF ROMAN AND EARLY BYZANTINE DATE

(Figures indicate numbers of fragments, except in the bottom row.
Taxa with a distribution limited to either the Mediterranean or the Red Sea are so indicated.)

Site	*Sagalassos*[1]	*Masada*[2]	*Tell Hesban*[3]	*City of David*[4]	*Tamara*[5]	*ez Zantur*[6]
Date	*1st-7th c. A.D.*	*1st c. A.D.*	*1st c. BC-4th c. A.D.*	*Early Roman*	*3rd-7th c. A.D.*	*4th-5th c. A.D.*
Families other than Scombridae						
meagre (*Argyrosomus regius*) (Medit.)	-	-	62	-	2	-
parrotfish (*Scarus* sp.) (Red Sea)	-	-	2	-	189	62
jacks (Carangidae)	3	1	-	-	-	-
mullets (Mugilidae)	1	1	-	-	30	-
groupers (Serranidae)	19	8	-	-	24	132
seabreams (Sparidae)	6	-	-	-	17	7
Clupeiformes indet.	2	-	-	-	-	1
emperors (Lethrinidae) (Red Sea)	-	-	-	-	7	60
scorpionfish (Scorpaenidae)	-	-	-	-	1	-
wrasses (Labridae) (Red Sea)	-	-	-	-	1	1
rabbitfish (Siganidae) (Red Sea)	-	-	-	-	-	5
Scombridae						
tuna (*Thunnus* sp.)	46	169	-	-	-	-
little tuny (*Euthynnus alletteratus*) (Medit.)	-	-	-	4	-	-
Euthynnus sp.	11	-	-	-	3	29
skipjack tuna (*Katsuwonus pelamis*) (Red Sea)	-	1	+	-	-	-
bullet tuna (*Auxis rochei*)	-	1	-	-	-	-
Auxis sp.	13	-	-	-	14	-
Atlantic bonito (*Sarda sarda*) (Medit.)	55	75	-	-	3	-
Spanish mackerel (*Scomber japonicus*)	7	-	-	-	-	-
mackerel (*Scomber* sp.)	3	-	-	-	-	-
Scombridae indet.	74	71	-	-	-	-
Scombridae total	209	317	83	4	20	29
% Scombridae of all marine fish	**87.1**	**96.9**	**56.5**	**100**	**6.9**	**9.8**

1 Van Neer and De Cupere, unpublished.
2 Lernau, Cotton and Goren 1996.
3 von den Driesch and Boessneck 1995. It was not possible to establish the exact number of skipjack tuna from the published data, but this was the only scombrid species retained after examination.
4 Lernau and Lernau 1992.
5 Lernau 1986.
6 Desse-Berset and Studer 1996.

discovered at Megiste,[75] Gemiler Adası near Fethiye, and Antiphellos near Kaş.[76] Additional fish-salting establishments may remain unrecognised at other E Mediterranean sites, however, as they did at Sabratha (Libya) and Banasa (Morocco), where structures were identified as fish-salting workshops only 60 or 70 years after their excavation.[77]

At inland sites in the Levant that have yielded the remains of marine fish, it is not always clear whether the fish came from the Mediterranean or the Red Sea.[78] At Masada, where

75 Pirazzoli 1987.
76 Zimmermann, pers. comm.
77 Wilson 2007.
78 Van Neer *et al*. 2004.

there is evidence for the storage of fish sauces in jars (one containing small fish bones, others bearing *tituli picti* referring to fish sauce), more than 300 other examples of fish remains, not associated with any container, were found in various parts of the site. These derive almost exclusively from species of Scombridae: the vast majority of the remains identified beyond the family level (n=246) belong to *Thunnus* sp. (tuna, 69%) and *Sarda sarda* (Atlantic bonito, 30%); *Katsuwonus pelamis* (skipjack tuna) and *Auxis rochei* (bullet tuna) are each represented by a single bone only.[79] The site is located 80 km east of the coast, but it has been suggested that these scombrid bones represent salted fish imported in amphorae from the same W Mediterranean factories where the fish sauce was produced.[80] It remains to be seen to what extent this hypothesis can be maintained, now that salting installations have begun to be discovered in the E Mediterranean as well. Stable isotope research on fish bone collagen may prove useful in future provenance studies,[81] but so far no such archaeometrical analyses have been undertaken in the Mediterranean region.

Another inland site in the Levant where large numbers of marine fish remains have been found in Roman levels is Tell Hesban (Jordan).[82] The presence of *Argyrosomus regius* (meagre), a Mediterranean species, suggests import from the coast, 100 km west of the site. Most of the material, however, derives from scombrids that were initially tentatively identified as *Katsuwonus pelamis* (skipjack tuna) and *Euthynnus affinis* (kawakawa or bonito).[83] The identification of the former was later confirmed by comparison with specimens in a more extensive reference collection, but during the re-examination it was no longer possible to attribute any of the bones to *Euthynnus affinis* (which is osteologically very similar to *Katsuwonus pelamis*).[84] Because of the abundant presence of skipjack tuna, a species that does not live in the E Mediterranean, it was suggested that the fish came from the Red Sea, *c.*250 km away. This conclusion, however, need not apply to all of the scombrids found at the site, and the possibility that some of the unidentified remains are those of Mediterranean species cannot be excluded.

Two other Levantine sites have yielded small quantities of scombrids that do not allow much discussion of provenance or type of product. In Early Roman contexts at the 'City of David' excavations in Jerusalem,[85] a few finds of tunids have been identified as *Euthynnus alletteratus* (little tunny), which would have been imported from the Mediterranean, 50 km to the west. The *castellum* of Tamara (NE Negev), occupied A.D. 270-635, has yielded bones of fish from the Jordan river, the Red Sea (170 km distant), and the Mediterranean (90 km).[86] The scombrids represent only 6% of the total number of fish bones found at the site. With the exception of a single find of *Sarda sarda* (Atlantic bonito), a typical Mediterranean species, their provenance (Red Sea or Mediterranean) is unclear.

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79 Lernau, Cotton and Goren 1996. The authors apparently consider skipjack tuna to be a Mediterranean species and may not have realised the implication of this identification. Until more material of the same species is found, or the identification of the single caudal vertebra is confirmed, it may be premature to consider it evidence for commercial contact with the Red Sea.

80 Lernau, Cotton and Goren 1996; Van Neer *et al*. 2004.

81 Barrett *et al*. 2008.

82 Lepiksaar 1995; von den Driesch and Boessneck 1995.

83 Lepiksaar 1995.

84 von den Driesch and Boessneck 1995.

85 Lernau and Lernau 1992.

86 Lernau 1986.

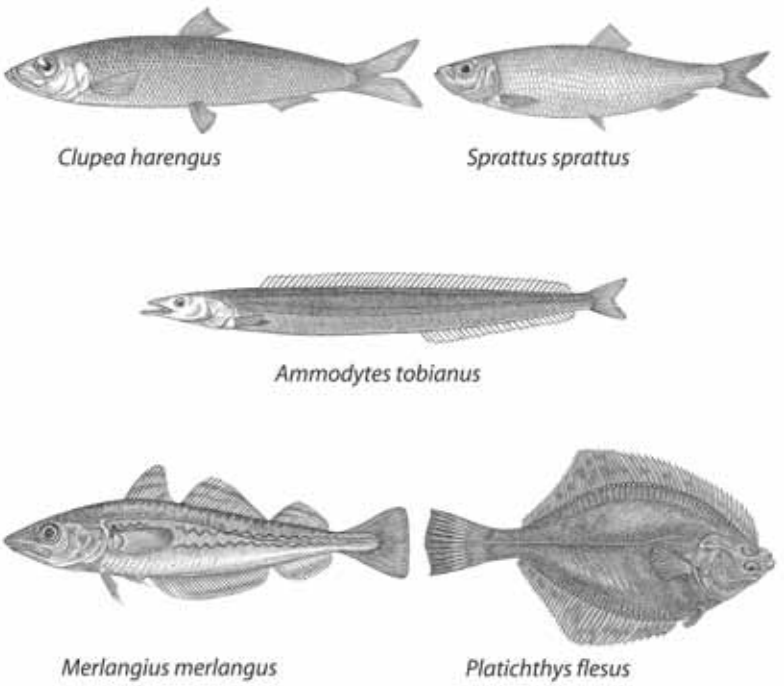

Fig. 5. Principal marine fish species used in locally-produced fish sauces in N Europe.

Evidence for local production of salted fish products outside the Mediterranean region

Products made from marine species

Over the last few decades, the careful sieving of animal remains from archaeological contexts in parts of the Roman empire far removed from the Mediterranean has yielded evidence for local processing of marine fish. One of the products documented by bones is a variant of fish sauce made with species occurring in N Atlantic waters, such as the North Sea. In general, however, archaeozoological evidence for this locally-made fish sauce is still rare. The relevant bones were first reported in 1982 from a context of the mid-3rd c. at Peninsular House, London;[87] since then, 10 further examples of similar salted fish products have been reported from Britain and Belgium (Table 3). No such finds have been mentioned in the literature from other countries, but this may be a result of inefficient recovery methods during excavation. It is striking that these finds all date from the mid-2nd c. or later. Small herring (*Clupea harengus*) and sprat (*Sprattus sprattus*) are the main ingredients in these preparations, although sometimes other taxa are abundant as well (fig. 5). The only salted product with large amounts of sand eel (*Ammodytes*) was found at Lincoln.[88] The remains from Zijdelingsestraat at Tienen represent the most diverse assemblage published thus far.[89] In descending order of frequency by minimum number of individuals (MNI), the following taxa were identified: herring/sprat, flatfish, sand eel, Gobiidae, hooknose (*Agonus cataphractus*), lesser weever (*Echiichthys vipera*), whiting (*Merlangius merlangus*), three-spined stickleback (*Gasterosteus aculeatus*), smelt (*Osmerus eperlanus*), sole (*Solea* sp.) and eel (*Anguilla anguilla*). This faunal spectrum indicates that the fish must have been

87 Bateman and Locker 1982.
88 Dobney, Jaques and Irving 1996.
89 Van Neer *et al*. 2005.

TABLE 3
COMPOSITION OF LOCALLY-MADE FISH SAUCES FROM BELGIUM AND GREAT BRITAIN

(Numbers of finds are followed by estimated MNI [minimum number of individuals]; FFF = very abundant.
The mixed sample from Tongeren, Kielenstraat, is not included here: see Table 5.)

Site	*Tienen, Zijdelingse-straat*[1]	*Tienen, Mithras*[2]	*Braives*[3]	*Arlon*[4]	*York, St. Mary Bishopshill Junior*[5]	*London, Peninsular House*[6]	*Beddingham*[7]	*Dorchester*[8]	*Dorchester*[9]	*Lincoln, Waterfront*[10]	*Chichester, 11 Chapel St*[11]
Date (all are A.D.)	*mid-2nd c.*	*2nd half of 3rd c.*	*3rd c.*	*2nd half of 3rd c.*	*late Roman-10th c.*	*mid-3rd c.*	*3rd c.*	*mid to late 2nd c.*	*4th c.*	*3rd-4th c.*	*4th c.*
Context	*refuse deposit in* vicus	*mithraeum*	*fill of well in* vicus	*fill of well in* vicus	*floor layer in town building*	*floor layer in town building*	*fill of pit in villa*	*oven in town*	*fill of latrine in town*	*refuse in town*	*town (garden)*
Anguilla anguilla	1/1	-	-	7/1	-	-	-	-	-	-	-
Alosa sp.	-	-	-	1/1	-	-	-	-	-	-	-
Clupea harengus and *Sprattus sprattus*	29635/2008	35/2	77/3	202/21	5756/45	?/7500	?/600	?/600-700	?/3200	FFF	?/1005
Sardina pilchardus	-	-	-	14/3	-	-	-	-	-	-	-
Osmerus eperlanus	2/1	-	1/1	-	-	-	-	-	-	-	-
Merlangius merlangus	498/16	-	3/1	5/1	1/1	-	-	-	-	-	-
Sygnatus rostellatus	-	-	-	10/2	-	-	-	-	-	-	-
Gasterosteus aculeatus	47/16	-	1/1	4/1	-	-	-	-	-	-	-
Agonus cataphractus	22/22	-	-	1/1	-	-	-	-	-	-	-
Dicentrarchus labrax	-	-	-	-	-	?/1	-	-	-	-	-
Echiichthys vipera	91/17	-	-	269/12	-	-	-	-	-	-	-
Spondyliosoma cantharus	-	-	-	2/1	-	-	-	-	-	-	-
Mugilidae sp.	-	-	-	2/1	-	-	-	-	-	-	-
Ammodytes tobianus	234/38	-	1/1	33/3	-	-	-	-	-	FFF	-
Callionymus sp.	-	-	-	1/1	-	-	-	-	-	-	-
Hyperoplus lanceolatus	-	-	-	-	-	?/1	-	-	-	-	-
Gobiidae sp.	65/22	-	-	16/5	-	-	-	-	-	-	-
Pleuronectidae sp.	1270/50	-	-	893/24	-	2/1	-	-	-	-	-
Scophthalmus sp.	-	-	-	3/1	-	-	-	-	-	-	-
Solea sp.	1/1	-	-	91/5	-	-	-	-	-	-	-
Tinca tinca	-	-	-	1/1	-	-	-	-	-	-	-
Cyprinidae sp.	-	-	-	4/1	-	-	-	-	-	-	-

1 Van Neer *et al*. 2005.
2 Lentacker, Ervynck and Van Neer 2004.
3 Van Neer and Lentacker 1994.
4 Pigière and Wouters 2008.
5 Jones 1988.
6 Bateman and Locker 1982.
7 Van Neer, Wouters and Jaques, unpublished.
8 Hamilton-Dyer 2008.
9 Ibid.
10 Dobney, Jaques and Irving 1996.
11 Locker 2007 and pers. comm.

obtained from an estuary, possibly that of the Scheldt river, rather than from a coastal marine environment.[90] An assemblage from Arlon (SE Belgium), still under study, yielded an even richer ichthyofauna dated to A.D. 250-80. It comprises at least 17 taxa of marine fish that occur in estuaries, and also some small cyprinids, such as tench (*Tinca tinca*), that can live in the same environment. The most numerous taxon is plaice, followed by lesser weever and clupeids. As noted above, clupeiform species (sardines, sardinellas and anchovies) were generally used in the preparation of the 'genuine' Mediterranean fish sauces. Not surprisingly, the major ingredients of the local sauces made from North Sea fish, small herring and sprat, are also clupeiform species. It appears that this particular group of fish, with its high fat content, was preferred in coastal areas for the local production of fish sauces.

The amphora types that abundantly document the import of Mediterranean salted fish products during the 1st c. A.D., especially in NW and central Europe, begin to decrease in numbers already at the end of that century.[91] At northern sites and even, to a lesser extent, in their region of origin, the Baetican, Narbonese and Lyonaise amphorae used for fish products are found much less frequently, and in some cases even disappear, in the 2nd c. A.D.[92] Baetican amphorae remain the most common, but are represented almost exclusively by the large Dressel 14A and Beltrán IIB types (figs. 3-4). These still bear painted inscriptions, but only a few of them have survived.[93] Although other centres continued to produce amphorae, they are rarely found outside the Mediterranean region. Only from the 3rd c. onward are exports again documented from *Lusitania* and *Africa* (see below).

What prompted the production of local fish sauces in NW Europe is still unknown. Perhaps it was necessary for local producers to satisfy Roman tastes because the import of 'genuine' Mediterranean sauces had already slowed in the early 2nd c. A.D. Alternatively, local production might have begun in competition with the southern products, made possible because of the cheaper cost of transport (and perhaps also of production). A change in clientele, either locally or in military installations along the *limes*, could also have played an important rôle, accompanied by a decrease in Mediterranean culinary influence, and with it a decline in demand for the 'original product'.

In addition to the faunal remains, there is other evidence that fish sauce continued to be consumed in Gaul and Germany after the 1st c. A.D., and that a substantial amount of it was locally produced. Salting installations, which could have produced for export as well as for local consumption, are known from the coast of Brittany, above all at Douarnenez and Etel. These may have been functioning as early as the 1st c. A.D., but were certainly active in the 2nd and 3rd c., and even later.[94] Elsewhere along the coasts of the N Atlantic and the North Sea, the production of fish sauce, probably in conjunction with the exploitation of salt, may have served as a form of import replacement as the northern provinces developed.[95] In the

90 Ibid.
91 Martin-Kilcher 1990.
92 There is a marked contrast with Gauloise 4 wine amphorae and Baetican Dressel 20 olive oil amphorae, which continued to increase during this period, reaching a peak under the Antonines: Brulet, Laubenheimer and Vilvorder 1992; Martin-Kilcher 1994; Baudoux 1996; Williams and Desbat 1999; Ehmig 2003; Monsieur 2005.
93 Beltrán Lloris 1970; Peacock and Williams 1986; Monaghan 1990; Martin-Kilcher 1994; Baudoux 1996; Hazenberg 2000; Ehmig 2002.
94 Merlat 1957; Sanquer and Galliou 1972; Galliou 1984; Driard 2008; cf. Immerzeel 1990.
95 Wilson 2006.

Fig. 6. Fragment of a *dolium* from Aardenburg (The Netherlands) bearing the graffito AL\\C XIS, interpreted as *allec* (Collectie Stichting Cultureel Erfgoed Zeeland, Middelburg NL, inv. no. 308-1).

civitates of the *Morini* and the *Menapii* on the Belgian and N French coasts, there is archaeological and epigraphic evidence for the production of salt,[96] but the coastal sites have never been excavated with attention to the recovery of small faunal remains. Further evidence, however, comes from several inscribed dedications found at the sanctuary of Nehallenia at Colijnsplaat (*Germania Inferior*), datable to *c.*A.D. 180-230.[97] Three of them (nos. A34, A39 and B44) bear the names of four *negotiatores allecarii*, merchants who specialised in fish sauce, while four others (nos. A1, A26, A49 and B1) bear the names of *negotiatores salarii*. Such documents make it difficult to avoid the conclusion that salt and fish products must have played an important rôle in local and regional trade. That part of the commerce was conducted with Britain is attested by another dedicatory inscription (no. A3), by a *negotiator cretarius Britannicianus*, a merchant in pottery based in Cologne. Two graffiti found in *Germania Inferior* are worth noting in this context: one, incised on the rim of a *dolium* found at the military site of Aardenburg (fig. 6), mentions *alec*;[98] the other, incised on the shoulder of a *dolium* discovered much further inland at Roermond on the river Maas, mentions *garum*.[99] It seems reasonable to assume that the *negotiatores allecarii* who honoured the goddess at Colijnsplaat were responsible for the sale and distribution of locally-made fish sauce, even if no salting installation has yet been discovered in the region.

No amphora types can be associated with the trade in North Sea fish sauce. The use of wooden casks, rather than the re-use of amphorae originally intended for other purposes, seems likely. As noted above, the discovery of Lyonaise amphorae of the 1st c. A.D. filled with fish sauce from the Iberian peninsula and *Narbonensis* suggests that the product must originally have been brought to Lyon in bulk, probably in wooden casks. Further evidence to support this conclusion is found in a funerary inscription on the sarcophagus

96 Thoen 1978; Martens, Debruyne and Vanderhoeven 2002. In a Flavian inscription discovered at Rimini (*CIL* XI 390) the *salinatores* of the *civitas Menapiorum* honour L. Lepidus Proculus, who served as *centurio* and *primipilus* in different legions. Noteworthy are the early date and the fact that a veteran was involved in the salt industry.

97 Stuart and Bogaers 2001; cf. Immerzeel 1990.

98 Trimpe Burger 1992; cf. Immerzeel 1990.

99 Hupperetz 1990, no date.

of M. Primus Secundianus, a *negotiator murarius* at Lyon,[100] which indicates that Mediterranean fish sauce could be transported in both amphorae and casks; the latter is even more likely in the northern part of the empire, although evidence is still lacking. Two of the inscriptions at Colijnsplaat (nos. A8 and A41) bear reliefs of a ship carrying wooden casks, but these, although not explicitly identified as the dedications of a *vinarius,* may nevertheless be intended to represent wine casks, since one of the reliefs also includes a depiction of grapes. On the other hand, S. Martin-Kilcher has suggested that the *simpulum* hanging on a wooden cask in a funerary relief from Augsburg points to fish sauce rather than to wine.[101] A Merovingian document of A.D. 718 from the Abbey of Corbie on the Somme records an order to purchase 30 *modii* of *garum* at the custom house (*cellarium fisci*) of Fos; although it is considerably later than the period under discussion here, the quantity suggests transport by wooden barrels rather than amphorae.[102]

In the case of the North Sea fish sauce, the archaeozoological evidence is relatively abundant, while the amphorae and *tituli picti* that might illustrate the trade are totally lacking. This stands in contrast to the trade in imported Mediterranean fish sauces, for which virtually no osteological evidence has been found in the northern part of the empire. Could it be that the North Sea product is relatively more 'visible' in the archaeological record because it often contained bones and/or scales? If so, could the term *allec,* which almost never appears in the *tituli* of Mediterranean fish-sauce amphorae found in the north, but is incised on the *dolium* rim at Aardenburg and used to describe the traders (*negotiatores allecarii*) on the altars from Colijnsplaat, specifically denote this northern product, which was often sold in unstrained form? To be economically viable, the long-distance trade in Mediterranean fish sauce may well have concentrated on high-quality, more expensive products, without bones and scales; on the other hand, it is unlikely that North Sea fish sauce always contained such débris: a higher-quality (and archaeologically invisible) product may have had its place in the market alongside the cheaper variety.

There is as yet no evidence for the production of North Sea *salsamenta* (as opposed to fish sauce) during the 2nd and 3rd c. Remarkably, in the northern part of the empire it is hard to find any evidence for the consumption of marine fish except in the form of fish sauce. A few finds of marine fish have occurred at inland sites, but it is not at all clear that they represent locally-produced *salsamenta* comparable to the genuine 'classical' product. The local production of fish sauce in the North Sea region has a parallel in the SE parts of the empire (Table 4). Here, too, the industry was organised around the catch of clupeiform species. Along the Egyptian coast of the Red Sea, the use of local clupeiforms to produce fish sauce has been documented at Quseir al-Qadim in a context dated to the 1st-2nd c. A.D.[103] Although the fish could not be identified precisely, it was determined that they were not Mediterranean species. Salted fish products made from Red Sea clupeiforms have also been found in several Late Roman contexts at the harbour town of Berenike.[104] Neither Quseir nor Berenike yielded any evidence of the way in which these local products were manufactured. No salting installations were found, and it is possible that production was organised on a smaller scale, using ceramic containers, as at Aqaba (see below). Apart

100 *CIL* XIII 1966, dated on epigraphic and stylistic grounds to A.D. 150-250.
101 Martin-Kilcher 1990.
102 Lestocquoy 1952; Jardin 1961; Curtis 1991.
103 Van Neer *et al.* 2006.
104 Van Neer and Ervynck 1998 and 1999.

TABLE 4
COMPOSITION OF FISH SAUCES FROM SITES ON THE RED SEA, IN THE EASTERN DESERT AND IN THE NILE VALLEY

(Numbers of finds are followed by estimated MNI [minimum number of individuals]. x = present, but not counted; FFF = very abundant.)

Site	*Quseir al-Qadim*[1]	*Berenike*[2]	*Petra*[3]	*Jabal Hārūn*[4]	*Mons Claudianus, Fort West II*[5]	*Mons Claudianus, Fort SE corner*[6]	*Quseir al-Qadim*[7]	*Shanhûr*[8]	*Bawit*[9]	*Kom el-Nana*[10]
Date (all are A.D.)	*1st-2nd c.*	*5th-6th c.*	*end of 4th-early 5th c.*	*late 6th-7th c.*	*1st-2nd c.*	*1st-2nd c.*	*1st-2nd c.*	*late 6th-early 7th c.*	*7th c.*	*5th-6th c.*
ontext	*refuse in coastal town*	*amphora bases and sherds from food prep-aration area*	*pilgrim's flask in house*	*refuse from Byzantine monastery*	*'costrel' pot from rubbish deposit/quarry site*	*amphora base from refuse area/quarry site*	*concentration in refuse of coastal town*	*organic deposit in storage area of domestic context*	*content of stored amphora/ monastery*	*midden deposit W30 at monastery*
Red Sea Clupeiformes	x	FFF	2224/42	x	-	-	-	-	-	-
Mormyridae sp.	-	-	-	-	-	21/1	-	9/1	?/1	-
Barbus sp.	-	-	-	-	-	-	73/15	-	?/83	-
Labeo sp.	-	-	-	-	152/6	5/2	1/1	-	?/121	-
Leptocypris niloticus	-	-	-	-	-	-	3/1	-	-	-
Cyprinidae sp.	-	-	-	-	27/-	85/-	646/-	-	-	-
all Cyprinidae	-	-	-	-	179/6	90/2	723/17	1329/67	-	-
Alestes sp./*Brycinus* sp.	-	-	-	-	4/2	-	-	-	?/18	-
Hydrocynus sp.	-	-	-	-	-	-	82/10	-	-	-
Alestiidae sp.	-	-	-	-	-	-	125/-	-	-	-
all Alestiidae	-	-	-	-	-	-	207/10	162/8	-	-
Bagrus sp.	-	-	-	-	-	-	4/1	1/1	?/1	-
Synodontis sp.	-	-	-	-	-	-	1/1	890/77	?/5	FFF
Siluroids sp.	-	-	-	-	-	-	3/-	-	-	-
all Siluroids	-	-	-	-	-	-	8/2	890/77	-	-
Cichlidae sp.	-	-	-	-	6/1	-	-	5456/109	?/1	-

1 Van Neer *et al*. 2006.
2 Van Neer and Ervynck 1998 and 1999.
3 Studer 1994.
4 Frösén *et al*. 2002.
5 Van Neer *et al*. 2006.
6 Ibid.
7 Ibid.
8 Van Neer and Depraetere 2005.
9 Van Neer *et al*. 2007.
10 Luff 2007; Van Neer *et al*. 2007.

from these two Egyptian sites, Red Sea fish sauce is also attested in Jordan: at Petra, inside a pilgrim's flask found in a context dated to the late 4th-early 5th c.;[105] and in a context of the late 6th-7th c. at the monastery of Jabal Hārūn,[106] proving that the industry in the Red Sea survived the collapse of the western empire.

Evidence for the local production of a specific type of fish sauce was found in a context of the 1st c. A.D. at Roman *Aila* (Aqaba), where tuna bones discovered in a 'ribbed-neck jar' of local ware have been interpreted as the remains of *haimation*, a product typically made from the gills and innards of tunids.[107] This is the first time that this particular sauce, highly prized by ancient authors (*Geoponica* 20.46.6), has been documented archaeozoologically. The bones come exclusively from the gill apparatus of medium-sized tuna of the genus *Auxis*, which has a wide geographical distribution. In this case, however, it was possible to rule out a provenance in the Mediterranean or Black Sea because of the presence in the bone assemblage of a single individual of a lizardfish (*Trachinocephalus myops*) that lives only in the Red Sea. This small fish is a prey species and must have been among the stomach contents of the tuna used to make the sauce. Taking into account the quantity of the gill apparatus and the amount of salt that had to be added, the calculated volume of the original mixture corresponded more or less closely to the volume of the jar. This, and the fact that the jar was locally produced, suggests that the sauce was produced at *Aila* itself in this very container.

In contrast to the situation in the northern provinces, there is some evidence for the local production of *salsamenta* in the southern and eastern parts of the empire (Table 2). Whether the presence at Masada of a single bone identified as *Katsuwonus pelamis* (skipjack tuna) can be taken as solid evidence for the import of salted fish from the Red Sea remains uncertain.[108] All other fish bones found at the site belong to Mediterranean species. At Tell Hesban (Jordan), the situation is different: here, almost all of the material represents skipjack tuna, indicating frequent imports from the Red Sea, *c.*250 km away.[109] However, as noted above, the possibility that some of the remaining unidentified scombrids came from the Mediterranean cannot be excluded. The majority of the marine fish with identifiable provenances found at the *castellum* of Tamara (Negev) are parrotfish which must have arrived in dried form from the Red Sea, but the origin of the scombrids at that site could not be established beyond doubt.[110] Finally, at ez Zantur, Petra, domestic contexts of the late 4th-early 5th c. A.D. yielded an assemblage of bones consisting exclusively of marine fish, all of which seem to have been imported from the Red Sea, *c.*100 km to the south.[111] The scombrids, representing 10% of the sample, were all identified as *Euthynnus* sp. and are believed to have been imported in salted form.

Products made from freshwater species

The foregoing discussion focuses on products made from fatty, marine fish, similar to the species used for Mediterranean fish products. There is, however, also evidence that

105 Studer 1994.
106 Frösén *et al*. 2002.
107 Van Neer and Parker 2008.
108 Cf. supra n.79.
109 Lepiksaar 1995; von den Driesch and Boessneck 1995.
110 Lernau 1986.
111 Desse-Berset and Studer 1996.

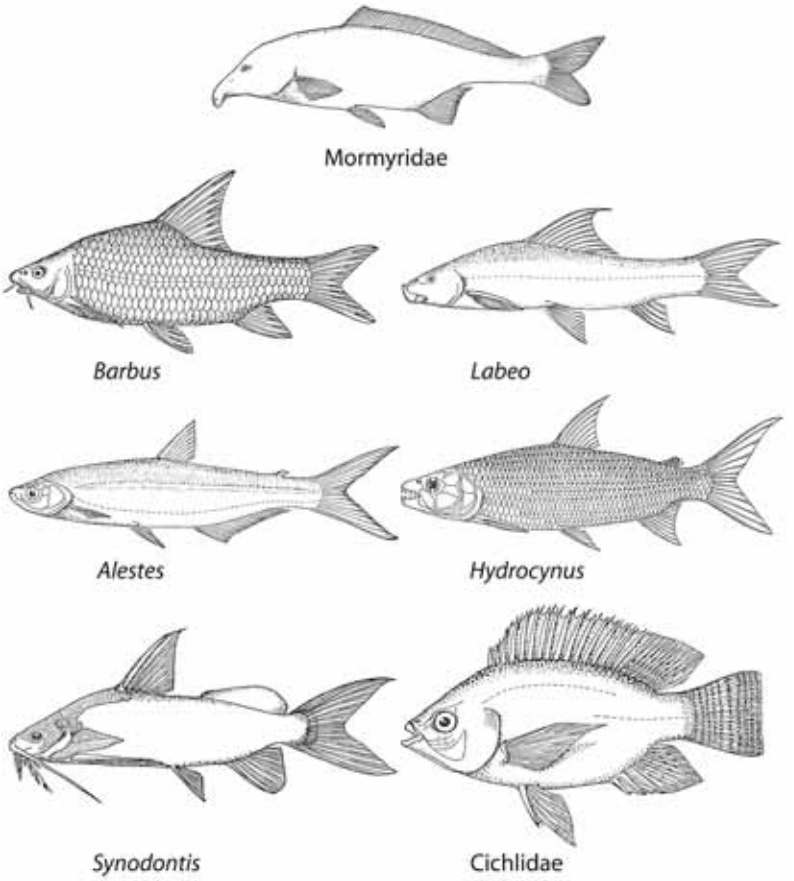

Fig. 7. Principal Nilotic fish used in locally-produced salted fish products in NE Africa.

small freshwater fish were sometimes processed to create local variants of salted fish products (Table 4). The most obvious examples occur at sites in Roman Egypt, where at least three such assemblages have been documented.[112] Bone concentrations of small Nilotic fish have been found in two contexts of the 1st-2nd c. A.D. at Mons Claudianus, *c.*120 km east of the Nile in the mountains above the Red Sea. The bones were found adhering to the base of a pitch-lined 'costrel' pot and a pitch-lined amphora of Nile fabric. A contemporaneous example, but without associated pottery, was found at Quseir al-Qadim on the Red Sea coast, *c.*175 km from the Nile. Given the distance of these sites from the Nile valley, the fish must have been cured for transport, and the presence of some articulated bones suggests that the product was *salsamenta* at Quseir al-Qadim and in one of the Mons Claudianus examples (Fort SE corner).[113] The other assemblage from Mons Claudianus (Fort West II) probably represents fish sauce. Nine different taxa of Nilotic fish have been identified in these assemblages (Table 4; fig. 7). Cyprinids are most numerous at both sites, but at Quseir al-Qadim there are also many small tigerfish (*Hydrocynus* sp.) and tetras (*Alestes* sp./*Brycinus* sp.). In all instances, the average size of the fish is small, no larger than 5 to 10 cm in standard length (SL).[114]

112 Van Neer *et al*. 2006.

113 Cf. Desse-Berset and Desse 2000.

114 Standard length = the length of the fish from the tip of the snout to the base of the tail.

The fish products from Mons Claudianus and Quseir al-Qadim are particularly valuable because they provide information about added spices, oils and vegetable matter, data that are typically not available from other parts of the empire. One of the assemblages from Mons Claudianus (Fort SE Corner) yielded remains of wheat (*Triticum* sp.), coriander (*Coriandrum sativum*) and crushed *Cordia myxa* (Egyptian plum).[115] The *salsamenta* from Quseir contained aromatic spices (mainly coriander) to flavour the product; a fragment of safflower fruit (*Carthamus tinctorius*), presumably an impurity in the safflower oil that was added to the mixture; and a lentil (*Lens culinaris*), which shows that legumes were added during production.[116] Some insect remains also indirectly confirm the addition of legumes.

Written documents, mostly in the form of private letters inscribed on ostraca, also preserve information about the food items that were sold or exchanged in the Eastern Desert of Egypt.[117] The commodities mentioned most frequently, however, are legumes, bread and meat; judging from the number of ostraca on which fish products are mentioned at Mons Claudianus, these were evidently not very common, and it is not usually clear in what form the fish were sold and what their provenance was. Faunal analyses show that the majority of the fish consumed at desert sites are from the Red Sea,[118] but at Mons Claudianus there are, in addition to the salted products made from small fish and discussed above, also remains of some larger Nilotic fish that most likely arrived in dry form.[119] In one of the ostraca texts, a purchase of dried fish is specifically requested.[120] Dried fish (most likely parrotfish among the Red Sea species, and mainly catfish and tilapia among the Nile species) may have been traded in baskets, as was sometimes also the case with meat.[121] Slices or pieces of fish are mentioned a few times;[122] these were probably transported in salted form, as was often the case with meat transported in jars or amphorae.[123] The rarity of any indication of the type of fish in these documents prohibits any firmer conclusions about provenance or method of preservation.

The processing of freshwater fish in this region is certainly older than the Roman occupation. The earliest evidence for the production of salted fish in the Nile valley comes from Kerma, in a context dated between 800 and 400 B.C.[124] It continued into Byzantine times, as shown by a midden deposit of the 5th-6th c. at the monastery of Kom el-Nana,[125] finds of the late 6th-early 7th c. from Shanhûr,[126] and bones of the 7th c. from the monastery of Bawit.[127] Catfish (*Synodontis* sp.) predominate at Kom el-Nana and Shanhûr, while at Bawit cyprinids (*Labeo* and *Barbus* sp.) are the most abundant taxon. Both *Labeo* and *Synodontis*

115 Hamilton-Dyer 2001, 284.
116 Van Neer *et al*. 2006.
117 E.g., at Mons Claudianus: Bülow-Jacobson 1992.
118 Van Neer 1997; Hamilton-Dyer 2001.
119 The remains of Nilotic fish, found not only in the Eastern Desert of Egypt but also in the Levant and Anatolia, were sold in dried form and probably transported in baskets: Van Neer *et al*. 2004. The trade in dried fish products of this sort falls outside the limits of the present study.
120 Bingen 1997a, 96.
121 Bülow-Jacobson 1992, 149.
122 Bingen 1997a, 83, 99, 109 and 112; id. 1997b, 119.
123 Bülow-Jacobson 1992, 128 and 134.
124 Chaix 1984; Chaix, Desse and Mohamed Ahmed 2008.
125 Luff 2007; Van Neer *et al*. 2007.
126 Van Neer and Depraetere 2005.
127 Van Neer *et al*. 2007.

are mentioned specifically on ostraca from Bawit.[128] *Faseekh*, salt fish made from Nilotic (or marine) species, is still very popular today in Egypt and Sudan.

Outside the Nile Valley, in the Levant, additional evidence has come to light for the production of salted fish using small freshwater species. O. Lernau, describing the discovery of numerous small tilapia (2.5-5 cm SL) under an overturned flat cooking pot in a context of the 5th-7th c. at Horvat Karkur (Israel),[129] relates these finds to a passage of Strabo (16.2.45 [C764]) which mentions salted fish production at Tarichaea, along the shore of Lake Galilee. An 8th-c. shipwreck of a trading vessel or fishing craft found off the coast of Israel produced several jars that also contained the bones of very small tilapia.[130] It remains to be determined, however, whether these fish are of Nilotic or Levantine origin, since tilapia occur in both regions.

In light of these examples of the use of freshwater fish to make processed fish products in the southern and eastern parts of the empire, it is worth considering the possible use of small freshwater species as an ingredient of fish sauces in the northern provinces as well. Indirect support for such an idea may be found at the Veemarkt site in Tongeren (Belgium), in the filling of a cesspit dated between the end of the 1st and the first half of the 2nd c. A.D.[131] Since the spectrum of species (Table 5) matches that of the local river Jeker, it is not necessary to invoke the idea of import from a distant area of production. The assemblage consists predominantly of cyprinids of small size, either because the species do not grow larger (as in the case of minnow *Phoxinus phoxinus*) or because small specimens of larger species were selected for use (as in the case of chub *Leuciscus cephalus* and dace *Leuciscus leuciscus*). At the site of Kielenstraat in the same town, a sample dating to the 2nd c. A.D. also contained numerous small fish remains.[132] Although these remains were not directly associated with pottery, they include marine species (young herring, sprat, flatfish and possibly three-spined stickleback) which are typical ingredients of a fish sauce. At the same time, however, they also include a large number of small freshwater species. As in the Veemarkt sample, cyprinids are the most frequently represented taxon and the spectrum of freshwater taxa fits that of the 'barbel zone' defined in the classification of NW European rivers by M. Huet.[133] Since these fish typically occur in the upstream areas of a river basin, the freshwater component of this assemblage cannot have been taken from an estuary, where the juvenile herring, sprat and flatfish are most likely to have been captured. It appears that two different types of products were deposited in this context, one of a more local, upland origin, the other from a more distant coastal or estuarine area. No assemblages consisting of a concentration of small freshwater fish are mentioned in a recent overview of fish consumption in Roman Britain,[134] or in other areas where archaeo-ichthyological work involving systematic fine sieving is practiced.[135] In the future, it may be worthwhile to consider the possibility that Roman assemblages of many small freshwater fish may represent the remains of salted products.

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128 Clackson 2002, 11.
129 Lernau 2004.
130 Barkai and Kahanov 2007; Van Neer, pers. obs.
131 Vanderhoeven, Ervynck and Van Neer 1993.
132 Ibid. 185.
133 Huet 1959.
134 Locker 2007.
135 E.g., Switzerland: Hüster Plogmann, pers. comm.

TABLE 5
COMPOSITION OF FISH ASSEMBLAGES FROM TONGEREN
WITH A LARGE NUMBER OF SMALL FRESHWATER FISH

(Numbers of finds are followed by estimated MNI [minimum number of individuals].)

Site	*Veemarkt*[1]	*Kielenstraat*[2]
Date (all are A.D.)	*end of 1st-1st half of 2nd c.*	*2nd c.*
Freshwater		
eel (*Anguilla anguilla*)	12/3	8/1
pike (*Esox lucius*)	3/1	-
barbel (*Barbus barbus*)	1/1	3/2
gudgeon (*Gobio gobio*)	1/1	3/2
minnow (*Phoxinus phoxinus*)	10/2	6/2
chub (*Leuciscus cephalus*)	3/2	-
dace (*Leuciscus leuciscus*)	7/5	-
Leuciscus sp.	-	15/4
rudd (*Scardinius erythrophthalmus*)	1/1	-
Cyprinidae sp.	65/6	486/14
brown trout (*Salmo trutta fario*)	6/1	-
Salmonidae sp.	-	10/1
stone loach (*Barbatula barbatula*)	1/1	-
perch (*Perca fluviatilis*)	4/3	15/1
Anadromous		
shad (*Alosa* sp.)	1/1	-
three-spined stickleback (*Gasterosteus aculeatus*)	1/1	13/3
Marine		-
herring and sprat (*Clupea harengus* & *Sprattus sprattus*)	-	257/18
flatfish (Pleuronectidae sp.)	-	1/1

1 Vanderhoeven *et al*. 1993. Upon re-examination of this material in order to calculate MNI figures for the present study, more taxa could be identified than was indicated in the original publication.
2 Van Neer and Ervynck, unpublished.

The economic significance of processed freshwater fish products in the northern Roman empire remains unclear. No other artefacts or epigraphic evidence associated with their production or sale have been identified, and the frequency of archaeozoological finds is impossible to evaluate in an economic context.

A revival of the trade in Mediterranean processed fish?

During the 3rd and 4th c. A.D., new amphora types began to be used for transporting fish products in the northern part of the empire, among them the Lusitanian Almagro 50A and Almagro 51C, and various N African types from *Tripolitania*, *Byzacena* and *Zeugitana*.[136] Some of these amphorae seem to have been used for both fish sauce and *salsamenta*. Lusitanian Almagro 50 and 51C, for example, are known to have carried sardines and mackerel, but installations for fish processing found near the amphora workshops suggest

136 Beltrán Lloris 1970; Parker 1977; Keay 1984; Peacock and Williams 1986; Etienne and Mayet 2002; Bonifay 2004.

Fig. 8. Lusitanian amphora (Almagro 51c type) for fish products, from Trier (*Gallia Belgica*) (Royal Museums of Art and History, Brussels).

that they were also used for fish sauce.[137] DNA analysis has determined the general functions, including the transport of fish products, of the N African amphorae, especially the large group of Keay 25 types.[138] None of these Lusitanian and N African amphorae bear *tituli picti*. Among the sites where amphorae of these types have been found are Lyon, Augst, Mainz, Rümersheim near Colmar, Strasbourg, Trier (fig. 8), Tournai, Oudenburg, Tongeren and London.[139] Some of these appear to be military sites (forts at Strasbourg, Rümersheim and Oudenburg; an arms factory at Tournai) or administrative centres (Trier). So far, however, these amphorae have been found in the north only in low quantities. Much less is known about the amphorae of the 5th and 6th c., after the retreat of the Roman army from Britain, the Rhineland and *Gallia Belgica*. Only one form is attested, the small N African amphora known as the '*spatheion*' type, probably to be dated between 400 and 425 and used for fish sauce.[140] Finally, as noted above, a Merovingian document from Corbie proves that Mediterranean fish sauce was still reaching the north in the early 8th c.[141]

How this Late Roman and Early Mediaeval trade in southern fish products should be interpreted is unclear. Is it a revival of the Mediterranean trade, made possible by a collapse of production in the north? Or are we again facing a problem of archaeological visibility? To what extent can the data from amphorae be used to draw conclusions about fish sauce and *salsamenta*? At present, sieved animal remains from Late Roman and Early Mediaeval contexts are rare in NW Europe because of the infrequency of sieving and the scarcity of the sites themselves, but further study and more refined excavation techniques will certainly affect our understanding of these issues.

As we have observed, the production of marine *salsamenta* in the north cannot be documented in Roman times. Indeed, it seems that during that period the larger varieties of North Sea fish generally did not reach inland sites, a pattern that, in Belgium at least, changed only towards the end of the first millennium A.D.[142] In this part of the former Roman empire, however, there is a growing body of data pointing to the occasional import of marine fish from the North Sea to Roman and also Early Mediaeval inland sites,[143] although whether these products have any link to traditional *salsamenta* is hard to prove and perhaps unlikely.

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137 Wheeler and Locker 1985; Delussu and Wilkens 2000; Etienne and Mayet 2002.

138 Piquès, Hänni and Silvino 2008.

139 Lyon: Bonnet *et al.* 2003; Augst: Martin-Kilcher 1994; Mainz: Ehmig 2003; Strasbourg and Rümersheim: Baudoux 1996; Trier: De Loë 1937, Gose 1972 and Mariën 1980; Tournai: Brulet 1994 and Vilvorder 1994; Tongeren: unpublished studies by P. Monsieur; Oudenburg: unpublished studies by P. Monsieur and S. Vanhoutte; London: Davies, Richardson and Tomber 1994; cf. Carreras Montfort 1998 for *Britannia*.

140 Keay 1984; Bonifay 2004.

141 Du Cange *s.v. garum;* Lestocquoy 1952; cf. Jardin 1961; Curtis 1991.

142 Van Neer *et al*., forthcoming.

143 Ibid.

Conclusions

Ample archaeological evidence has been published for the production of fish sauce along the Mediterranean and the Atlantic coasts of the Iberian peninsula, and the products themselves have been rather well documented by bone finds in the Mediterranean area. Remarkably, however, outside this region there is almost no archaeozoological evidence for the consumption of Mediterranean fish sauce. The scarcity of faunal remains contrasts strongly with the abundant evidence provided by amphorae and their painted inscriptions, which mention a variety of Mediterranean fish sauces and prove that these southern products were exported to the north, at least during the 1st c. A.D.

There is now growing evidence for the production of a number of local varieties of fish sauce in areas of the empire outside the Mediterranean region. In the northern provinces, archaeozoological finds attest to fish sauces made from N Atlantic species, such as small clupeids (herring and sprat), sometimes also with small flatfish or sand eel as major ingredients. In some instances, the variety of species present, together with their small size, clearly indicates that the fish were taken from an estuary rather than a coastal marine environment. The production sites for these local sauces, however, remain largely unknown. They must have been associated with salting installations located at the mouths of rivers, but archaeological evidence for such installations is scant. To date, the only certain example is in Brittany, but epigraphic data also point to salt production in N France, Belgium and The Netherlands, especially in Zeeland. It remains to be determined whether these activities were generally small-scale enterprises or whether they reached an 'industrial' level. The distribution of the products is also difficult to follow, because the containers used for their storage and transport remain unknown. We should probably imagine wooden casks, or perhaps recycled amphorae originally made for other purposes, but the evidence is again scant. The use of small, local clupeiform species for fish sauces is also attested along the Red Sea coast in Egypt and in Jordan, although here again no evidence of actual production has been found. At Roman Aqaba, however, a concentration of tuna gill bones found in a locally-made jar appears to confirm the production of fish sauce (*haimation*) at the site.

The small fish used in salted products were not limited to marine species, as demonstrated in Egypt by the Nilotic species used for the production of both fish sauces and *salsamenta*. A similar practice in the Levant is suggested by literary evidence and two archaeozoological examples from Israel that slightly postdate the Roman period. Small freshwater fish may occasionally have been used in the northern provinces as well, but the evidence is still limited.

The production of local fish sauces in the north seems to be a rather late phenomenon (2nd-3rd c. A.D.). This chronology, together with the fact that the amphora types which typically contained salted products from the south were by this time very rare, suggests that local production was organised to satisfy the demand of consumers who still had 'Roman' tastes, but who could no longer easily buy Mediterranean products. It is, however, also possible that local fish sauces were produced in commercial competition with the products from the south, eventually pushing them out of the northern market.

The trade in *salsamenta* in the northern provinces exhibits a different pattern. A growing number of archaeozoological finds attest to the import of salted fish from the south, mainly Spanish mackerel. Most of these finds are early and reflect the thriving import trade in southern products during the 1st and the beginning of the 2nd c. *Tituli picti* prove that these products were transported in amphorae as well as in other containers. In this case,

however, there is no evidence that an alternative local product was manufactured once the import of southern *salsamenta* diminished. It seems that the consumption of larger, salted fish from southern centres of production simply ceased, without being replaced by a comparable northern product (unless the rare finds of flatfish and herring at inland sites should be re-interpreted in this context). A resurgence of the trade in salted products seems to occur in the Late Roman period, with the renewed arrival of southern amphorae in northern markets. More data, however, especially that provided by the recovery and analysis of archaeozoological remains, are needed to shed light upon this trade.

wvanneer@naturalsciences.be
Royal Belgian Institute of Natural Sciences, Brussels and Katholieke Universiteit Leuven, Laboratory of Animal Biodiversity and Systematics, Leuven (W.V.N)
Flemish Heritage Institute, Brussels (A.E.)
Department of Archaeology, Ghent University, Gent (P.M.)

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